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Internal and external perspective on gender equity in STEM field

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Abstract

This article introduces an approach aided by Artificial Intelligence based on Large Language Model approaches designed to assess the status of the gender equity in Science, Technology, Engineering and Maths (STEM) subjects comparing data gathered from two types of surveys carried out among Academic and Non-Academic environments. We conducted the Academic study in the Department of Engineering and Geology at the University "G. d'Annunzio" of Chieti-Pescara (UdA), Italy, and the Non-Academic one among a broader public audience mainly composed of common people and students who took part in the Researchers' Night 2024 at the University Campus of Chieti. The study adopted a dual approach: an Academic level analysis – named Internal Analysis – examines departmental data and dynamics, and a Non-Academic level analysis – called External Analysis, evaluates perceptions and awareness of gender equity among the participants to the Researchers' Night 2024 at the Chieti Campus, who were involved in interactive games and questionnaires focused on gender representation in STEM fields. The outcomes illustrated and discussed hereinafter offer preliminary insights into gender gaps, stereotypes, and potential pathways to fostering greater inclusion and equity in working and living around the STEM world. Creating a more inclusive and equitable ground requires actively supporting the presence and interaction of diverse viewpoints, especially those shaped by different gender experiences. Men and women may bring distinct approaches, values, and ways of evaluating situations, encouraging an open dialogue between different perspectives that can enrich strategic thinking and

lead to more robust and well-rounded outcomes both at institutional level and in human relationships.

Keywords: STEM, Gender equality, Artificial Intelligence, Gender balance, Academic and non-Academic life.

1. Introduction

Despite significant advancements in recent decades, gender equality in Science, Technology, Engineering, and Mathematics (STEM) remains a global challenge (Falco et al., 2023; Gaiaschi and Musumeci, 2020; Agnini et al., 2020; Picardi et al., 2023; Biemmi et al., 2023). Women continue to be underrepresented in many STEM disciplines, particularly in engineering, computer science, geology and physical sciences (Agnini et al., 2020; Heimann, 2025; Heimenn and Johansson, 2024; Holmes et al., 2008). For instance, a comprehensive analysis of over 34 million bachelor's degrees awarded in the U.S. from 2002 to 2022 revealed that men considerably outnumber women in physics, engineering, and computer science majors, with a recent male-to-female ratio of approximately 4:1 as reported in the web page "UNESCO – Gender Equality in Science, Technology, and Innovation". It provides an overview of UNESCO's efforts to promote gender equality in STEM fields, including data on women's representation in scientific research and initiatives to support gender equality in science and technology (UNESCO, 2025).

Educational initiatives and policy reforms are critical to addressing these disparities. The report *UNESCO – 2024 Gender Report: Technology on Her Term* assesses progress toward achieving gender parity in education, focusing on how technology can support or hinder gender equality in education and STEM fields (Saini, 2019; UNESCO, 2024a). Specifically, it emphasizes the importance of encouraging girls to pursue STEM subjects from an early age and ensuring that technology is designed to be inclusive and supportive of gender equality. Similarly, the *World Bank's report, The Equality Equation*, advocates for addressing gender biases in learning materials, engaging parents, and promoting partnerships with the private sector to close gender gaps in STEM (World Bank, 2020).

Gender disparities are not only a matter of social justice but also hinder scientific innovation and economic progress. According to the European Commission's Gender

Equality Strategy 2020-2025, structural inequalities persist across Europe, including gender pay gaps, unequal career advancement opportunities, and underrepresentation in decision-making roles (EU, 2020). In response, institutions and governments, especially within the European Union, have launched numerous initiatives, including the EU Gender Action Plan 2021-2025, which aims to integrate gender perspectives across all external policy areas and promote women's empowerment worldwide. Furthermore, the UNESCO "Call to Action: Closing the Gender Gap in Science" is an initiative that calls for urgent multi-stakeholder collaborative actions to dismantle gender stereotypes, open educational pathways for girls in science, and create empowering workplace environments to promote gender equality in science (UNESCO, 2024b).

While progress has been made, the path toward full gender equality in STEM requires a multidimensional approach that addresses education, workplace culture, policy, and societal attitudes. In this paper, we analyse the state of gender equality in STEM based on the activities carried out by the Gender Equality Working Group that was established in March 2024, within the Department of Engineering and Geology of the University "Gabriele d'Annunzio" of Chieti-Pescara (UdA), Italy. The Gender Equality Working Group is a multidisciplinary team composed of faculty members from various STEM fields, including civil engineering, biomedical engineering, geology, physics, mathematics, and computer science. The group is committed to promoting equal opportunities, inclusiveness, and a supportive academic environment whose primary objectives are:

- Promote Gender Balance in STEM: encourage greater participation of women and underrepresented groups in engineering and geological sciences through awareness campaigns, mentoring programs, and outreach initiatives aimed at schools and early-career students.
- Raise Awareness and Foster Cultural Change: organize seminars, workshops, and training sessions on unconscious bias, gender stereotypes, and inclusive teaching practices to promote a culture of respect, awareness, and collaboration among staff and students.
- Data Monitoring and Policy Recommendations: collect and analyse gender-disaggregated data on faculty, students, and staff to identify gaps and trends in representation. Based on these findings, the group develops evidence-based policy proposals and actions to be presented to the department.
- Promote Work-Life Balance and Wellbeing: advocate for policies and practices that support work-life balance, such as flexible scheduling, parental leave, and support services for caregivers, to create a more equitable working environment for all.
- Collaborate with Institutional and External Bodies: maintain active collaboration with the university's central gender equality office (CUG) and engage with national

and international networks working on gender equity in STEM to share best practices and enhance the group's impact. By aligning with both the Gender Equality Strategy of the European Union (EU) and institutional frameworks, the working group aims to foster a diverse and inclusive academic environment where everyone can thrive and contribute equally to the advancement of science and technology.

Different activities have been organized by the Gender Equality Working Group over the past two years:

- A moment of guided reflection on the theme "Gender Beliefs", so that each member of the department can have stimuli for their own growth and awareness about gender equity issues.
- A talk with the philosopher Lorenzo Gasparrini, a well-known Italian speaker on gender issues especially aimed at male audiences, titled *Gender Equity: The Male Perspective and the Challenges of Change*.
- A seminar with Maria Giuseppina Pacilli, Associate Professor of Social Psychology at the University of Perugia, Italy, and author of the book *Uomini Duri, il lato oscuro della mascolinità* (Pacilli, 2020), titled *Gender Stereotypes and Scientific Knowledge: What's the Connection?*

Finally, as the Gender Equality Working Group, we decided to propose the following activity for the Researchers' Night 2024, titled *Science Without Barriers: Equity and Inclusion in STEM*. This was a hands-on lab activity designed to engage the Researchers' Night audience with the theme of gender equality in STEM subjects through interactive and engaging games and questionnaires.

This paper further advances in the direction of the initiatives promoted by the Gender Equality Working Group introducing an approach aided by Artificial Intelligence (AI) based on Large Language Model (LLM) approaches for the analysis of gender gaps in STEM. It allowed us to (i) analyse data collected within the Department of Engineering and Geology, and (ii) collect new data during the Researchers' Night 2024 and analyse them, to understand the current state of gender equity both within the department and in a broader context, such as that of external visitors who came to the Chieti Campus during the Researchers' Night event.

The structure of this paper is as follows. In Section 2, we present the approach aided by AI based on LLM approaches adopted to collect and analyse the data. In this context, we conduct an internal-level analysis of gender equity focusing on the specific situation within the Department of Engineering and Geology, and an external-level analysis of the state of gender equity based on insights from the broader audience of Researchers' Night visitors who took part in the activity we

proposed. In Section 3, we describe how the datasets were built, using both official sources on departmental staff and the distribution of questionnaires for adults and children during the Researchers' Night. In Section 4, we present the results along with related graphs, which are then discussed in Section 5. Finally, in Section 6 we draw conclusions about the study, also outlining future work directions.

2. The proposed AI-based methodology

The research methodology proposed in this study combines both internal and external analyses to provide a comprehensive view of gender equity in the STEM fields. The aim is to explore long-term trends in gender representation among academic staff, and to assess current perceptions and experiences related to gender dynamics within the STEM environment. An LLM is employed as an AI tool to design questionnaires (Henry et al., 2024; Troussas et al., 2024). They include both quantitative and qualitative items aimed at capturing experiences of gender bias, access to opportunities, work-life balance, and the general climate regarding gender inclusivity in STEM.

a) Internal analysis: gender representation through time
   The first part of the methodology is based on an internal analysis of gender equity, focusing on the evolution of gender proportions across different academic roles within the department over the period 2012-2024. Official institutional records are reviewed to quantify gender distribution among various hierarchical levels, including research fellows, assistant professors, associate professors, and full professors. This internal analysis allows for the identification of trends in representation, potential stagnation points, or areas of improvement in gender balance, particularly in leadership and decision-making positions.
b) External analysis: perceptions from Chieti-Pescara community
   Complementing the internal study (focused on measurable data), an external analysis (focused on perception) is directed toward a broader context beyond the department. This is achieved through the design and distribution of a structured questionnaire generated by LLM targeting a diverse group of participants. The AI tool generates a questionnaire for adults aiming at gathering opinions and reflections on the challenges, opportunities, and possible solutions for improving female representation in STEM fields. The same AI tool is also applied in developing the questionnaire for children, designed to spark their curiosity and encourage them to reflect on the importance of women's roles in STEM subjects.

The questionnaires are administered in person during the official scientific events at the university campus. This strategy provides a unique opportunity to engage

with a broad audience, including students at different school grades, local citizens, and occasional patrons. Questionnaires are distributed at dedicated booths and discussion areas, with voluntary and anonymous participation.
The collected responses are analysed using a combination of descriptive statistics and thematic content analysis. This dual-level approach, combining data and perceptions, allows for a multifaceted understanding of the actual state of the gender equity within and outside the department (among common people), linking structural patterns with lived experiences.

3. Experimental setting

To investigate the state of gender equity within STEM disciplines at the Department of Engineering and Geology, we performed an internal analysis extracting data from the website https://cercauniversita.mur.gov.it/ (accessed 23 January 2026) that aggregates possible searches regarding the University, from degree courses to funding, from professors to university students, from announcements to statistics. Extracted data were related to the years 2012-2024 to capture meaningful differences over the 12 years. Each data instance represents a professor or researcher in terms of (i) name, (ii) gender, (iii) role, (iv) scientific disciplinary sector, (v) competitive sector, and (vi) department name. From these data, for each considered year, we computed statistical measures in terms of percentage of male and female employees, and, for each gender, the percentage of researchers, associate professors and full professors.
For the external-level analysis, we adopted a mixed-method approach centred around the design and distribution of a structured questionnaire, as outlined in the methodology proposed in Section 2. The questionnaire aimed to gather qualitative and quantitative data on participants' perceptions, experiences, and suggestions related to gender equality in the academic and professional environment. The questionnaire was developed with support from an LLM. These models were employed to generate, refine, and validate a set of questions that would ensure clarity, inclusiveness, and relevance to the context of gender equity in STEM. The use of LLMs allowed for the integration of diverse linguistic and conceptual perspectives, minimizing potential human biases, and enhancing the neutrality of the language used in the survey.
In particular, we asked the LLM to report the different criteria adopted to design a questionnaire free of gender stereotypes. The obtained criteria are the following:

1) Use neutral and inclusive language, avoiding assumptions about gender identity, roles, or behaviours.
2) Avoid binary or restrictive response options, offering inclusive choices when gender information is relevant.

3) Ensure questions do not imply traditional gender norms, such as expectations about work-family balance or career paths.
4) Focus on behaviours, experiences, and perceptions, rather than characteristics linked to gendered assumptions.
5) Pilot-test items for bias, verifying that no question privileges or marginalizes any gender group.

The experimental process included the following steps:

1) Initial Draft Generation
   An initial pool of questions was generated using a GPT-based LLM. We adopted basic ChatGPT 4.0 in 2024. Prompts were tailored to produce items covering key areas such as workplace climate, career advancement, gender-based perceptions, access to opportunities, and experiences of bias or discrimination.
2) Expert Review and Iterative Refinement
   The AI-generated questions were reviewed by members of the Gender Equality Working Group, composed of faculty staff members from various STEM disciplines. The questions were then iteratively refined to align them with the STEM's specific context, ensuring disciplinary relevance and cultural appropriateness (Levy et al., 2024; Ding et al., 2025; Balestri, 2025; Liu and Wang, 2024; Garrido-Muñoz et al., 2024).
3) Pilot Testing
   A pilot version of the questionnaire was distributed to a small group of faculty, staff, and students to evaluate clarity, response variability, and overall usability. Feedback from the pilot phase was used to revise ambiguous items and optimize the questionnaire's structure and length.
4) Finalization and Distribution
   The final version of the questionnaire included both closed-ended questions (Likert scales, multiple choice) and open-ended questions to allow for more nuanced responses. It was distributed in person during the Researchers' Night 2024, held on Friday, September 27, 2024, at the University Campus in Chieti. The event, themed "We Care", featured over 260 scientific and cultural activities, attracting students, researchers, and the local community. The questionnaire was made available at designated booths and during interactive sessions throughout the evening.

The methodology ensured both rigor and innovation, combining human expertise with the generative capabilities of AI to create a tool able to capture meaningful insights into gender dynamics in STEM.

As part of our data collection process, we administered two separate questionnaires: one targeted at adults (older than 13 years) and another specifically designed

The Role of Women in STEM
1. Do you know any famous women in the STEM fields? If so, who? A. Yes, and I can name a few. B. Yes, but I can't recall their names. C. No, I don't know any.
2. Do you believe there are specific barriers that women face when entering STEM fields? A. Yes, many. B. Yes, some. C. No, I believe there are no significant differences.
3. What do you think are the main obstacles for women in STEM careers? (Select all that apply) A. Gender stereotypes. B. Lack of female role models. C. Workplace discrimination. D. Work-life balance. E. Other (please specify).
4. How important do you think it is to have more women represented in STEM fields? A. Very important. B. Quite important. C. Slightly important. D. Not important.
5. In your opinion, how can female participation in STEM be encouraged? A. Specific mentoring programs. B. Greater visibility of female leaders in STEM. C. Corporate policies promoting gender equity. D. Changing school curricula to encourage girls. E. Other (please specify).
6. Which STEM field do you think has the lowest female representation? A. Science. B. Technology. C. Engineering. D. Mathematics.
7. Have you ever considered a career in the STEM field? A. Yes, and I am currently pursuing it. B. Yes, but I changed my mind. C. No, I was never interested.
8. Do you believe that women have the same career opportunities as men in STEM? A. Yes, absolutely. B. Partly, but there are still challenges. C. No, there are many disparities.
9. Which policies or initiatives do you think are most effective in increasing female presence in STEM? A. Scholarships specifically for women. B. Gender quotas in hiring and promotions. C. Awareness campaigns in schools. D. All of the above. E. None of the above.
10. What is your opinion on the future of women's presence in STEM? A. It will improve significantly. B. It will improve slightly. C. It will remain the same. D. It will get worse.

Table 1. *Questionnaire for adults.*

Women and STEM Subjects
1. Do you know what STEM means? A. Yes, I know it stands for Science, Technology, Engineering, and Mathematics. B. No, I don't know.
2. Do you know any famous women who work as scientists, engineers, or mathematicians? A. Yes, I know a few. B. No, I don't know any.
3. Do you think girls are as good as boys at math and science? A. Yes, absolutely! B. No, I think boys are better. C. I'm not sure.
4. Would you like to do a job when you grow up that involves science, technology, engineering, or math? A. Yes, I would really like that. B. No, I don't think so. C. I don't know yet.
5. Have you ever seen girls doing science experiments or building things at school? A. Yes, often. B. Yes, but not very often. C. No, I've never seen that.
6. Do you think it's important for girls to also have jobs like scientists or engineers? A. Yes, it's very important. B. Yes, it's quite important. C. No, it's not important.
7. What do you think when you see a girl working with computers or building something? A. It's great, she can do anything! B. It seems strange, usually boys do that. C. I've never thought about it.
8. Would you like to have more stories or books about girls making scientific discoveries or inventions? A. Yes, I'd really like that. B. No, I'm not interested. C. Maybe, it depends on the story.
9. Why do you think it's important for girls to study science and math too? A. Because everyone can learn new things and make discoveries. B. Because that way more people can work in those fields. C. I don't know why.
10. If you were a teacher, how would you get girls more interested in science and math? A. I would do fun experiments for everyone. B. I would tell stories about famous women in these fields. C. I would play games with numbers and science. D. I wouldn't know what to do.

Table 2. *Questionnaire for children.*

for children (younger than 13 years). Every child was accompanied by one of the parents, who gave authorization to answer the questionnaire. This effort resulted in two distinct anonymized datasets. The adult questionnaire received a total of 159 responses, while the children's questionnaire yielded 61 responses. These datasets served as the basis for our subsequent analyses at external level. The questions

considered in the questionnaires represent the attributes of the datasets, while the possible answers represent the values of the attributes. This results in 10 attributes for each dataset. For greater clarity, Tables 1 and 2 below present the questionnaires proposed for adults and children.

4. Results

In this section, we present the results of the internal and external analyses conducted on gender equity in STEM world.

4.1. Internal-level Analysis Results

The analysis of the gender distribution among academic staff in the Department of Engineering and Geology at UdA between 2012 and 2024 (see Figure 1) reveals both quantitative and hierarchical shifts. In 2012, the department employed a total

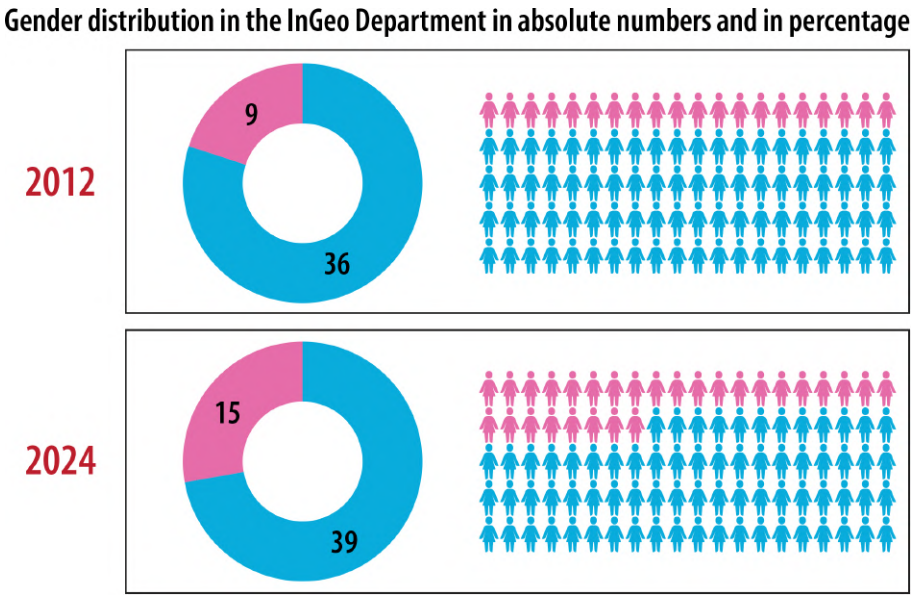

Figure 1. *Gender distribution in the Department of Engineering and Geology (InGeo), UdA, Italy.*

of 45 staff members: 36 men and 9 women, with women representing 20% of the academic staff. By 2024, the total number had increased to 54, with 39 men and 15 women, raising the proportion of female up to approximately 28%. This indicates a positive increase in female representation over the 12-year period.
In terms of hierarchical roles (see Figure 2), data from 2012 emphasized obvious gender gaps. Among full professors, there were 9 men and 1 woman. At the associate professor level, the imbalance persisted with 18 men and only 1 woman. In contrast,

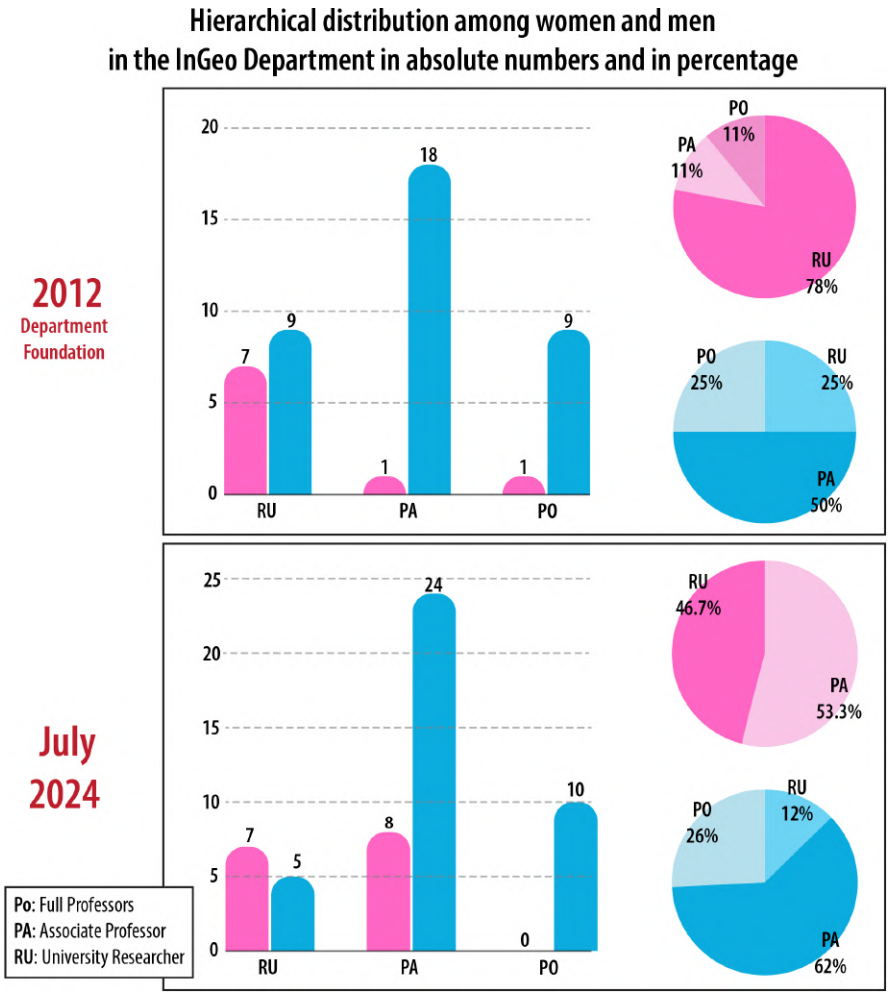

Figure 2. *Hierarchical distribution among women and men in the Department of Engineering and Geology (InGeo), UdA, Italy.*

the researcher category showed a more balanced gender distribution, with 9 men and 7 women.
By 2024, the distribution across roles had evolved unevenly. Among full professors, the number of women dropped to zero, while the number of men increased slightly to 10. Conversely, the number of female associate professors rose significantly to 8, compared to 24 male counterparts. Among researchers, women maintained a stable presence with 7 individuals, while the number of male researchers declined to 5, indicating a reversal of the previous gender majority in this category.
To analyse the significance of these data, we refer to Section 5, where additional aspects are explored and examined in greater depth.

4.2. External-level Analysis Results

The data distributions from adults and children's questionnaires are reported in Figures 3-6. The two samples composition, as shown in Figure 3, is quite different: Figure 3a (adults), reveals a female predominance: 65% versus 30% of male.

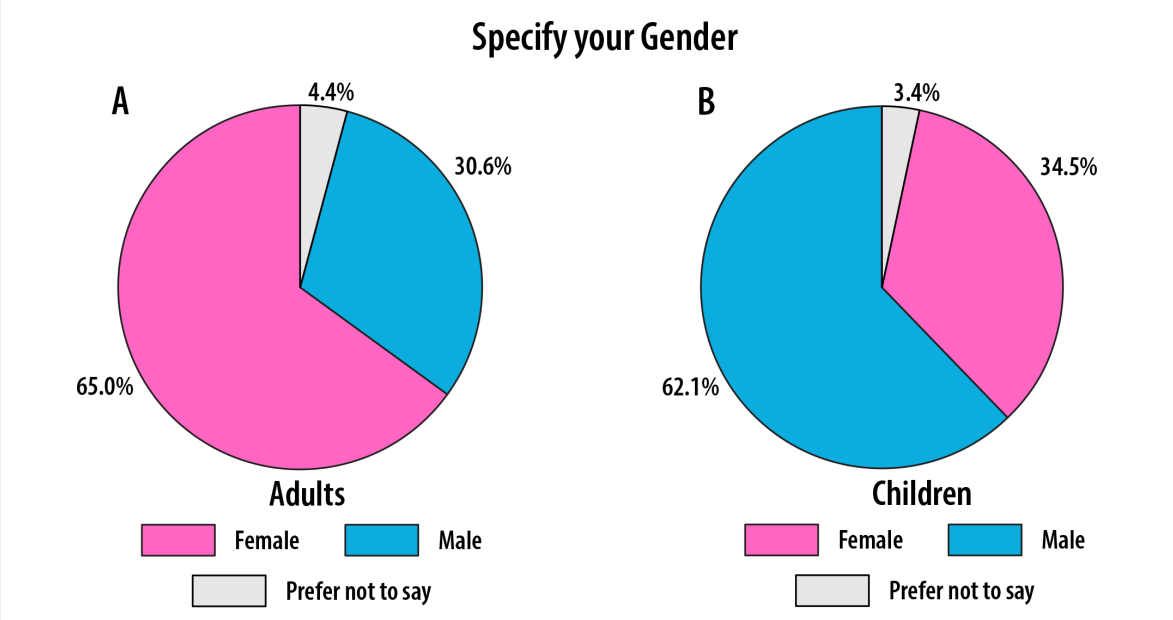

Figure 3. *Gender distribution from the adults (a) and children (b) datasets. 'No' means no answer given.*

Conversely, Figure 3b (children), inverts the proportions between female and male: 62% male and 35% female. The presence of a limited percentage (4.4% in adults and 3.4% in children sample) of no-gender can be interpreted as a deliberate choice within both samples, considering the ranges of age of the respondents (adults are strictly older than 14 years while children are 13 years old or younger). Looking at the children sample (Figure 4), most respondents (72%) fall between 6 and 11 years old (elementary school) while the rest is not defined.

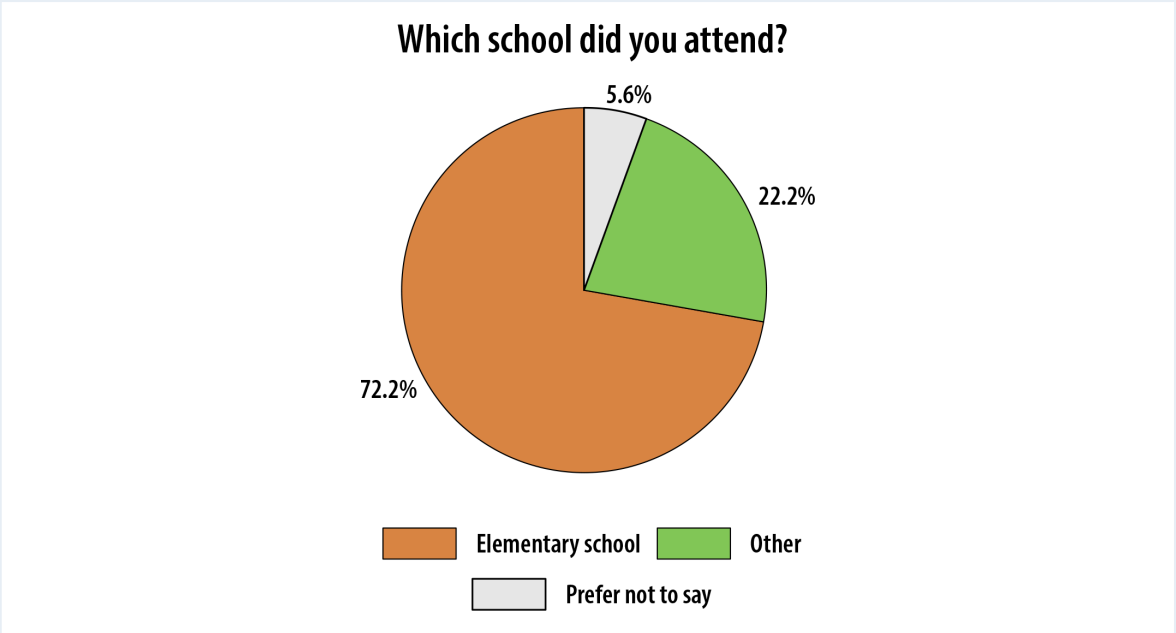

Figure 4. *School attendance distribution from the children dataset.*

Figure 5 reports the answers of the adult sample: 77% of the respondents claim to know famous women and almost the 74% admit the presence of specific barriers that prevent women to study and work in STEM fields. Then, several options are provided to describe the obstacles for women to develop a carrier in STEM subjects. The answers are, unsurprisingly, distributed across all available options. About 30% point to gender stereotypes and 25% to work-life balance, which are the most frequently cited reasons, while an additional 18% believe that these two factors are jointly responsible. Thus, the overall 75% agree that gender stereotypes and work-life

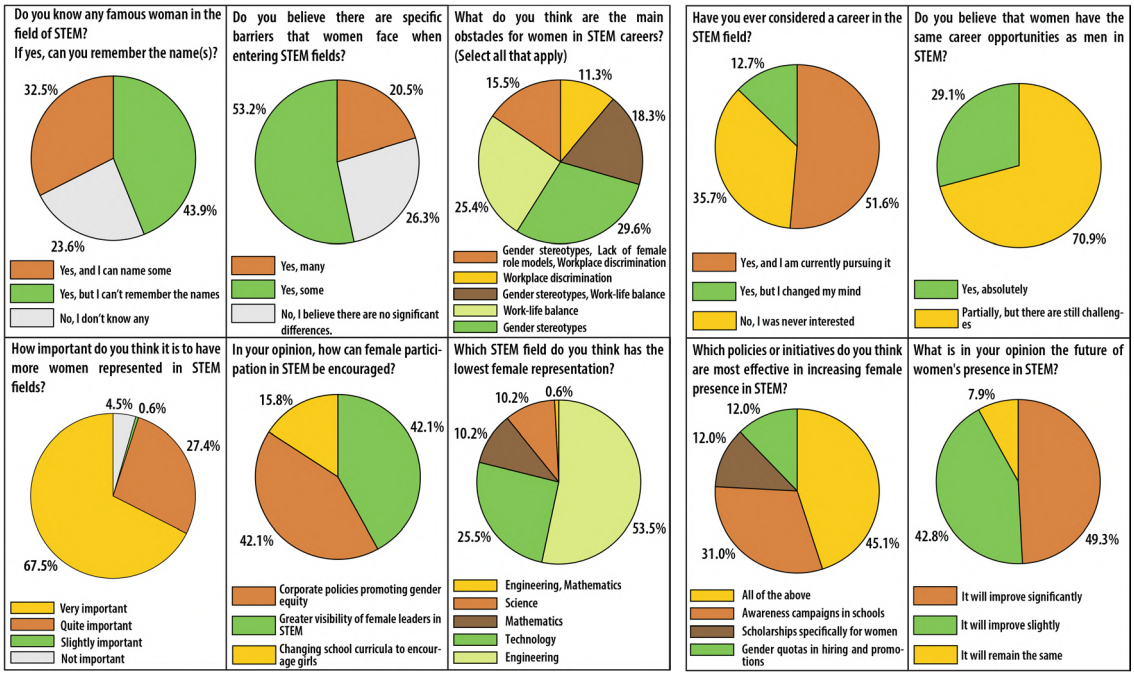

Figure 5. *Results obtained from the adult dataset.*

balance are the main reasons for the women shift in STEM compared to men. Furthermore, 11% of the adult sample believes that workplace discrimination is an obstacle that must be addressed in order to achieve gender balance in STEM.
A noteworthy finding is that 95% of adult respondents agree on the importance of women's presence in STEM fields to inspire girls to engage with these subjects. This result is strengthened by the opinion shared at 84% of the respondents about the measures to be implemented to promote the gender equality, that are equally distributed as large as 42% on increasing women visibility as leaders and company policy for women. Then, the respondents point out that Engineering at 53.5% and Technology at 25.5% have the least female representation: these two fields within the STEM area are thought as historically underrepresented by female students. Additionally, the women underrepresentation in the STEM field is thought, at 95%, to be responsible for girls not to be attracted by STEM.
Afterward, a question on the involvement in STEM field is formulated and the results point out that about 52% of the respondents are currently involved against the 48%

who resigned (12%) or have never thought to be involved (36%). This outcome can be read as a free choice of students if not considering the subsequent question, that is if men and women have equal career opportunities in STEM: for the 71% of respondents the equality is still a challenge while 29% opine that it is true. So, the two answers (about girl involvement in STEM and the equal career opportunities) suggest that the 12% of resignments could be due to the lack of favourable conditions for women in STEM studies.

Finally, regarding the policies effectiveness for increasing the female involvement in STEM, the most of respondents (45%) suggested a combination of multiple measures such as dedicated scholarships to female, awareness campaigns in schools, and gender quotas in hiring and promotions. However, the awareness campaigns collected 31% of responses meaning that a common belief is the education has a paramount importance in promoting gender equality in STEM. The final question related to future expectation for female in STEM shows an optimistic attitude of the respondents: 49% believe that the presence of women in STEM will increase significantly, while 43% expect a slight increase. Therefore, the adult sample appears to be aware that gender equality in STEM will be progressively achieved although a strong action towards girls' involvement in STEM is needed at present.

Results from the children's questionnaire (see Figure 6) are more ambiguous: 45% does not know the meaning of STEM acronym while 55% does. Many of them, 62% know some famous women in STEM while 38% does not. However, when the questions start to be more personal, they seem to believe in gender equality. The third question, in fact, asks if boys and girls are both good at math and science. Their answer at 82% is definitively yes. Only 8.3% think boys are better. Then, 57% would like to work in the STEM field against 16.7% who do not want. 27% of the children do not know about their future job, but this percentage is acceptable considering the presence of very young children (all of them are under 13 years old).

Looking at the subsequent questions: at 70% children said they are used to seeing girls doing experiments in science or building something, while at 93% they state the absolute importance of girls working as scientists and engineers. Following, most of the children respondents show their enthusiasm to see girls working at the computer or building something (73%) and their interest in storytelling about girls' scientific inventions and discoveries (68.3%). Furthermore, 93% opine that it is important to see girls getting scientific achievements as boys do because everyone can learn new things and make discoveries in a free society. Finally, 62% agree to use fun experiments for everyone to make girls more interested in STEM. At the last two questions, the large percentage of children' answers imply a gender equity approach on female and male. Thus, future efforts to reduce gender imbalance must explicitly address and counter the effects of social conditioning.

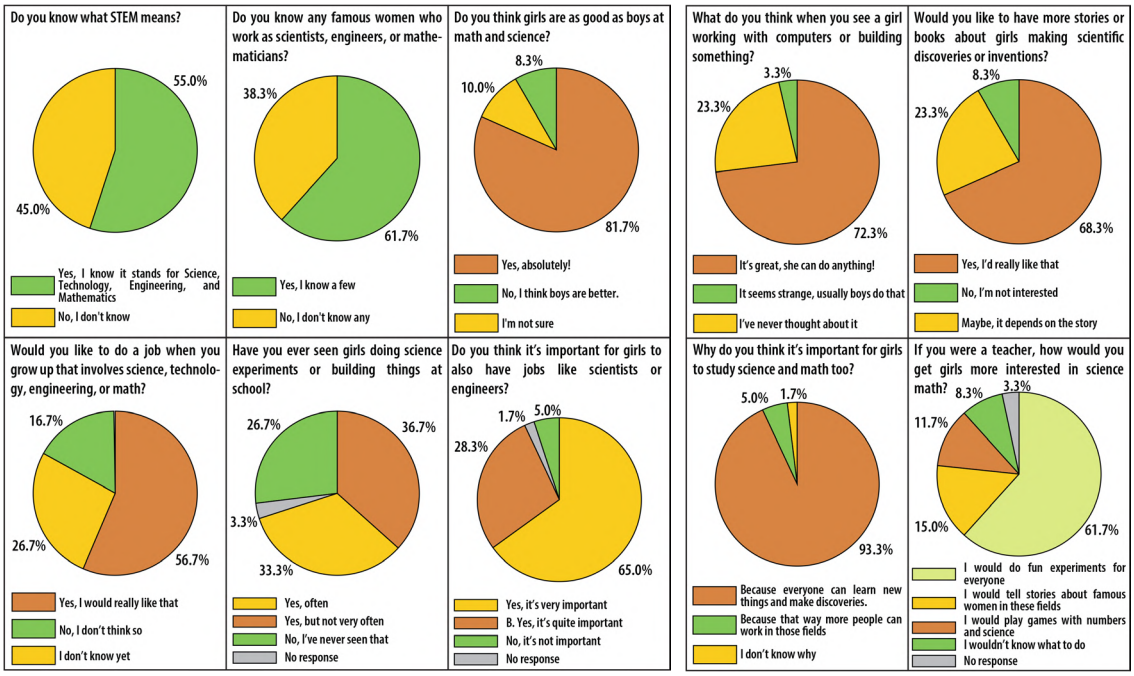

Figure 6. *Results obtained from the children dataset.*

5. Discussion

Over the past 12 years, the Department of Engineering and Geology at UdA, has shown encouraging signs of progress in gender equity. The analyzed data showed that female representation in the department has grown steadily, with an increasing number of women among new researchers enriching the department with greater diversity and inclusivity, fostering a more dynamic and forward-looking environment with the ambition and capability to shape the future. Specifically, the total number of women in the department increased from 9 in 2012 to 15 in 2024, marking a significant 67% growth. This is a strong indicator that more women are entering the academic and research environment in STEM subjects especially engineering and geology. One of the most notable achievements is the overall increase in female participation, which outpaced the growth in male staff. This suggests that efforts to attract and include more women in the department have been effective.

In 2012, women made up a large majority of the researcher positions, accounting for 78%. This percentage increased to 94% in 2024, confirming that the absolute number of women in this role remained substantial. This shift may reflect a more balanced recruitment strategy and possibly the promotion of some women to higher academic ranks. Although the percentage of women in associate professor roles remains low (dropping from 11% to 6%), the presence of women in this rank indicates that there is a pathway for career progression. The department now has a foundation to build upon, and with continued support and targeted initiatives, this number can grow in the coming years. Importantly, the data show that gender equity is a visible and measurable part of the department's evolution. The rise in female representation, particularly in entry-level academic positions, marks a positive step toward long-term equity. With sustained commitment, this progress can extend to higher academic ranks and leadership positions. In the future, to keep an inclusive and balanced environment, it is essential to encourage the coexistence of diverse perspectives, particularly those informed by different gendered experiences. Male and female visions may differ in approach, priorities, and evaluative criteria, and fostering dialogue between them can lead to more comprehensive and resilient institutional strategies. Achieving this goal requires creating spaces for interaction and exchange, not only on scientific topics but also on broader organizational and cultural issues. Through regular opportunities for open discussion, members of the department can move beyond individual assumptions and unconscious biases, which are often shaped by personal histories and lived experiences. Such engagement will ultimately contribute to a more equitable, innovative, and cohesive academic community.

A broader comparison with national Italian statistics further highlights the significance of the department's progress. Across Italy, women in STEM represent roughly 40% of researchers, around 30% of associate professors, and only 20-24% of full professors. These proportions decline with academic rank, reflecting a well-documented glass-ceiling effect. The department's 94% female representation among researchers is therefore markedly higher than the national STEM average. Even its modest share of women among associate professors remains consistent with national patterns, where female representation typically declines sharply in the transition from researcher to professor. Geographically, Italian data show meaningful differences between macro-areas. At the researcher level, the national ratio is about 84 women for every 100 men. This ratio varies noticeably: the South and Islands show the highest gender balance with approximately 92 women for every 100 men, while the North and Center report lower values, around 80 and 81 respectively. The department, located in the South, surpasses even the most favorable national regional data, given its near-parity – and in fact female-majority – researcher composition. At senior levels, the national pattern remains uneven. Across Italy

there are about 37 women for every 100 men among full professors, and in the central regions this value falls to approximately 34. Although STEM-only regional data for full professors are not officially published, the available evidence suggests that under-representation is severe everywhere. In this context, the department's limited number of female associate professors reflects the national challenges, yet the strong pipeline of female researchers' positions is more favorably for future improvement than many departments across the country.

Furthermore, the results of the questionnaire (external analysis) confirm that early perceptions of STEM subjects among children do not appear to be strongly influenced by innate differences in talent, inclination, or interest based on gender. A significant majority of respondents – both boys and girls – expressed confidence in the idea that girls are equally capable in STEM fields and demonstrated enthusiasm when seeing girls engaged in technological or creative activities. These findings support the growing body of research suggesting that gender disparities in STEM are not rooted in biological or natural predispositions, but it emerges gradually while children are getting older. Social influences, including stereotypes, cultural expectations, and representation in media and education, start shaping the self-perception and interest in STEM subjects, often discouraging girls over time despite early signs of equal ability and enthusiasm. Recognizing that these differences are socially constructed rather than innate is essential for designing effective interventions. By focusing on the critical early years of education through inclusive practices and positive reinforcement, educators and policymakers can help prevent the emergence of gender-based gaps in confidence, participation, and achievement in STEM fields.

6. Conclusion

This study introduced an approach aided by AI based on LLM approaches for evaluating gender equity in STEM, focusing on both institutional and public perspectives. By integrating internal departmental data with insights gathered from public engagement activities, such as those conducted during the Researchers' Night 2024, the research highlighted the encouraging progress in promoting gender equity within STEM environments. Women have increasingly entered academic and research roles, particularly at the early-career level, indicating that efforts to foster inclusion are having a positive impact. While representation in higher academic ranks remains limited, the growing presence of women suggests a foundation for future advancement.

Beyond the academic life, the public perceptions, especially among children, reflect a belief in equal capabilities between genders in STEM, with enthusiasm

for female participation in technical and creative fields. These trends highlight that gender disparities are largely shaped by social and cultural factors rather than innate differences, underscoring the importance of early, inclusive educational strategies to support long-term equity. Our proposed dual-level analysis emphasized the importance of fostering inclusive environments that valued diverse gender experiences and perspectives. The findings supported the need for sustained efforts to promote open dialogue, challenge stereotypes, and implement strategic actions to support equity. Such initiatives prove essential not only for achieving gender balance but also for enhancing the overall quality and resilience of academic and professional STEM communities. The study conducted in this paper has allowed us to define several objectives for the future activities of the department's Gender Equality Working Group. These include:

1) internal actions such as keeping on monitoring gender representation and career progression using data, organizing meetings and seminars aimed at raising awareness about gender equality among the male and female members of the department;
2) external actions devoted to bringing to the largest possible audience (particularly for students and teachers across all educational levels) the STEM methods and innovations promoting the gender equity in school and family life.

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